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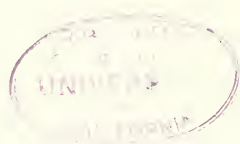
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"It adds a precious seeing to the eye."

—Shakespeare; Love's Labour's Lost.

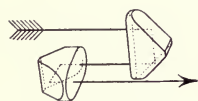


THE WARNER & SWASEY PRISM TERRESTRIAL TELESCOPE

Complete with

ALT-AZIMUTH MOUNTING, FOLDING TRIPOD
AND CARRYING CASE

The Warner & Swasey Prism Terrestrial Telescope



*Path of Light through
the Porro Prisms*

This Porro Prism instrument represents the highest development in Terrestrial Telescopes. Its relation to the ordinary telescope is the same as that of our Prism Binocular to the old type of field-glass. It is remarkable for its large field, brilliant illumination and clear definition.

The objective is 2 inches in diameter, clear aperture. Two eye-pieces are provided, magnifying respectively 25 and 50 diameters. The telescope tube and the alt-azimuth mounting are made of aluminum. The folding tripod is of carefully selected ash. All are contained in a neat leather-covered carrying case; total weight only twelve pounds. Weight of telescope with its tripod and mounting, apart from case, but six and a half pounds.

The high quality of its optical equipment, and the simplicity and adequacy of its mechanical provisions, make it superior to any similar telescope upon the market for the camper, the traveler, the motor-tourist, the surveyor, or the marksman upon the rifle-range. It is especially adapted for porch, seaside and general use.

While thus designed strictly as a terrestrial telescope, its purchasers have also found it of much interest and value in the field of amateur astronomy. It is not presented as—in the technical sense—an astronomical telescope; and yet its quality is so superior that its efficiency is actually greater than that of many larger astronomical telescopes heretofore offered to the public. The ease with which it can be moved from place to place in the observation of moon and stars, its sharp definition and breadth of field, combined with the precision and steadiness with which the instrument may be "pointed" and controlled, have brought many expressions of satisfaction from those who having first purchased it as a terrestrial telescope have subsequently tested it in their observations of celestial objects. To respond to the interest and the demand thus indicated, and to illustrate, for beginners, some of the simple astronomical uses of the Warner & Swasey "Prism Terrestrial," this little booklet has been prepared.

Our long experience in making "Optik Tubes" of all sizes, from the great Lick and Yerkes Telescopes to the Telescopic Gun Sights, Range Finders, Sextants, etc., used by the Army and Navy, especially qualifies us to develop from both a scientific and practical standpoint, the highest type of Porro Prism Telescope.



By Starlight and Moonlight

WITH THE WARNER & SWASEY
PRISM TERRESTRIAL TELESCOPE

Introductory

The beginner naturally asks, "What is there to see? What objects in the sky will my telescope reveal?" It will help toward an appreciation of what his little instrument will do for him, if we can first help him to understand some of the things which even the largest telescope—in direct proportion to its excellence—will not do for anyone.

There are results which are mathematically as impossible for an optical instrument as for a fine watch to tick seventy-five seconds to the minute. Your telescope cannot work well through a misty atmosphere, or through air heavy with cloudiness or smoke. It will not work well if you permit the steadiness of your tripod to be affected by the winds, or if—when you place it on your porch—the floor on which it rests is shaken by heavy walking. Inasmuch as the atmosphere close to the earth is more subject to disturbance and impurity than the air a little higher up, your instrument will work better on objects at a slight altitude than on objects lying close to the horizon.

Yet even this two-inch instrument (modest indeed as compared to those largest telescopes of the world—the great instruments made by The Warner & Swasey Company for the Lick and the Yerkes Observatories) will give you gratifying results. There is a peculiar fascination in being easily able to point your instrument at a bright star and to find—perhaps to your surprise—that it is not a single star, but a "double" or a "triple." It is even more charming to be able to discern in a double star the contrasted colors of the components,—one, perhaps, being a golden yellow, the other a distinct blue or a delicate emerald.

A few of the coarser doubles may be divided by a field-glass, but everyone knows the difficulty in holding a field-glass steady; and the power commanded by this little telescope is so much greater than that available in a binocular that many doubles which

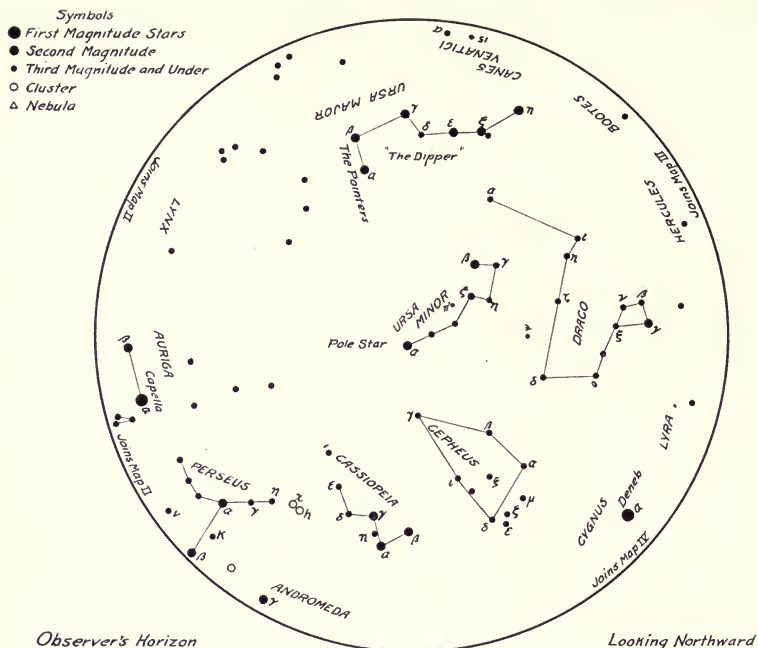
no field-glass can divide will yield instantly to its persuasion. And as your tripod does the holding, you can gaze at your leisure and comfort into a steady field.

When Halley's comet comes again into view (it is scheduled to reappear late in 1909, becoming still more conspicuous in 1910) the possession of an adequate telescope, even though a small one, will add much to one's pleasure in following its course. Objects, moreover, that are quite familiar to us—such a star-cluster for example as the Pleiades—assume through this little instrument a scope and brilliancy quite unsuspected by the naked eye. Clusters, also, like those in the sword-hand of Perseus and like the "Bee-hive" in Cancer; nebulae like those in Andromeda and Orion; the four greater satellites of Jupiter; the ring-formation and at least one of the satellites of Saturn, and much of the strange and beautiful topography of our own moon—are brought within the range of vivid interest and appreciation. A telescope that will easily divide such double stars as Castor, and the Gamma in Virgo; that will reveal so clearly the contrasted colors of such doubles as Mizar and Albireo, and that will show—even with a power of 50—the trapezium in the sword of Orion, is not to be despised by anyone, and holds—for the beginner—many possibilities of pleasure.



Part I.

Single Stars Double Stars
The Planets



GUIDE MAP No. I. This Map of the Northern Sky Joins, and overlaps the tops of Maps II, III, IV.

On some evening when the air is clear and steady, place your telescope on its simple mounting, and come with it out of doors. Bring with you, for your greater comfort while observing, a plain straight-backed chair, preferably without arms.

Let us face directly north,—to get our bearings by the Great Dipper and the North Star. During May, at 9 o'clock in the evening, for example, you will find the Dipper just before you, directly to the northward and very high up. During July and August, you will see it further to your left in the northwest, the handle following the bowl and the bowl turning slowly downward, as its stars make their apparent revolution about the pole of the heavens. Late in the autumn, you will find it low down, directly to the north, its bowl turned upward; and in the winter, you will see it climbing upward to your right, in the northeast, but with its bowl turned toward the west.

In noting this apparent revolution of the Dipper, we have taken 9 P. M. as the hour of observation. As it takes approximately twenty-four hours to complete its turning, we shall find it at 8 P. M. less far advanced upon its course; at 10 P. M. or at 11 P. M., we shall find it proportionately further forward. A few minutes' observation for an evening or two will make these directions clear; but as many may wish to study more fully the motions of the stars, and as all ought to have larger knowledge of the important constellations (an easy and delightful subject of popular information) some elementary books of reference are given on page 37; see also paragraph 9, page 36.

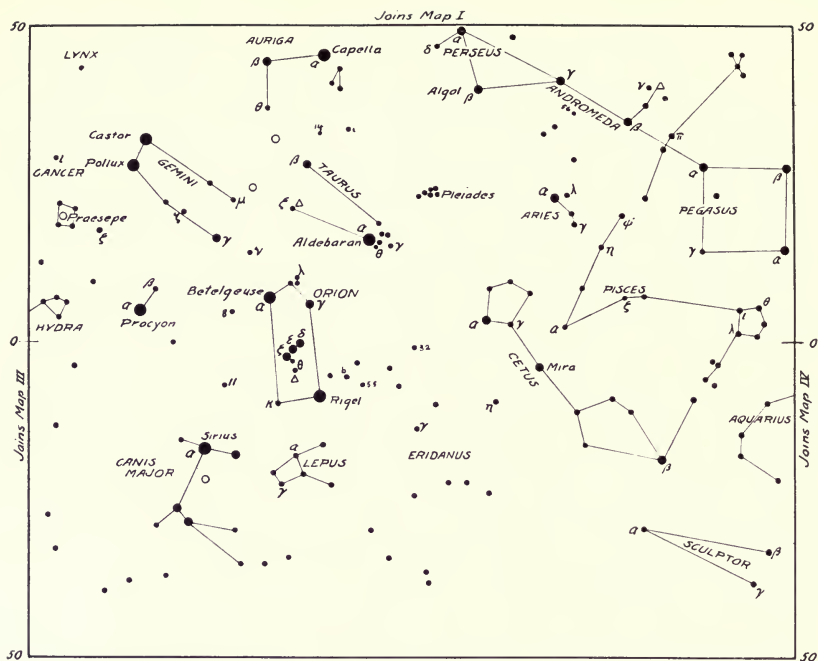
First let us look at Mizar, the star marked Zeta (ζ) in the bend of the Dipper's handle. The reader who is not familiar with the characters of the Greek alphabet will quickly pick them up as we go along; some of the stars have no other designations.

Quite near to Mizar you will note, if the air is clear, a little star that may sometimes be seen with the naked eye. Using your 25 x eye-piece, turn your telescope upon them. Be sure to get a clean, sharp focus. You will observe at least four objects in the field. You will see Alcor, the smaller star to which we have referred, and another fainter star, and by looking closely at Mizar (the brightest of the group), you will discover that it is a "double." Now, having once found these in your telescope, slip in the 50 x eye-piece, and the division between Mizar and its close companion will be clearer still. (The magnitudes of the components are 2.4 and 4.2.)

Now let us look somewhat further from the pole, near the edge of our little map, at a star which the Dipper's handle (if it were continued in a curve) would quite enclose. This is Alpha in "The Hunting Dogs" (Canes Venatici). It is sometimes called Cor Caroli, the Heart of Charles, in honor of Charles I of England. Your 25 x will show it to be a charming double. (The magnitudes of the components are 3.1 and 5.7.)

In searching for a star with the telescope, it is well to use the less powerful eye-piece. Having found the object, you can then slip in the higher power if you desire. Let us now follow with our eyes the general direction indicated by the "Pointers" in the bowl of the Dipper. Not stopping, however, at the Pole Star, let us continue the imaginary line as far again, right across the northern sky. We are now in the neighborhood of the constellations Cepheus and Cassiopeia. Almost at the center of Cepheus, we shall find the little star Xi (ξ); magnitudes 4.4 and 6.5. You may find it a little difficult. Turning, however, to one of the corners of the house-shaped figure, we shall find an especially easy and very pretty "double" in the star Delta (δ); magnitudes 3.7 and 5.1, and we shall find another in the head of Draco, the Dragon. From the star Delta (δ) in Cepheus let the eye project an imaginary line to Alpha (α) in the same group—continuing it approximately the distance of the Dipper's total length. You will thus come readily to the stars that mark the Dragon's head. The star Nu (ν) is the faintest of the four; but even with your 25 x eye-piece you will be rewarded by the brightness of its two components, (magnitudes 4.9 and 4.9).

And now before leaving the northern stars let us return again to the region right across the northern sky from the Great Dipper. Still using your low-power eye-piece, sweep through the rich fields of Cassiopeia till you reach the neighborhood of the star Alpha (α) in Perseus. This is one of the most brilliant sections of the sky. Note especially the star-clusters marked (X) and (h). They have symbolized for ages "the sword-hand" of the hero Perseus. Of course a larger instrument would give a more adequate impression of their scope and splendor, but our little telescope will reveal much of the beauty of the scene.



GUIDE MAP No. II. This Map Overlaps Map I at the Top and Map III and IV at the Sides.

We have already spoken of the region of the sky in the neighborhood of the star Alpha (α) in Perseus. We find Perseus in the northeast late in August and the early autumn; in the northwest during February and the early spring. At the right side of Map II toward the top, you will find this part of the sky repeated, for the tops of the oblong maps we now employ are "overlaps" connecting the circumpolar stars with the other stars of the sky. You will also see the star Beta (β)—or Algol, by name—and you will note that a line drawn from Beta (β) to Alpha (α) will form a right angle with one drawn to the star Gamma (γ) in Andromeda. The latter is one of the most charming of all the double stars (magnitudes 2.2 and 5.0); the colors of its components are orange and a delicate emerald. It will repay close observation with both your eye-pieces.

Next let us look at the well-known group called the Pleiades. They appear in the east in the early evenings of late September, reach their highest point above us early in January and continue till April in the western sky. They are so far distant that their light, traveling at the rate of more than 186,000 miles a second, takes more than two hundred years to reach us. The average unaided eye can discern but six or seven; turn your little instrument upon them—using your 25 power eye-piece—and you will see the shining of hundreds.

Now let us turn our telescope upon the region about Aldebaran, the red eye of Taurus, the Bull. The stars that here make

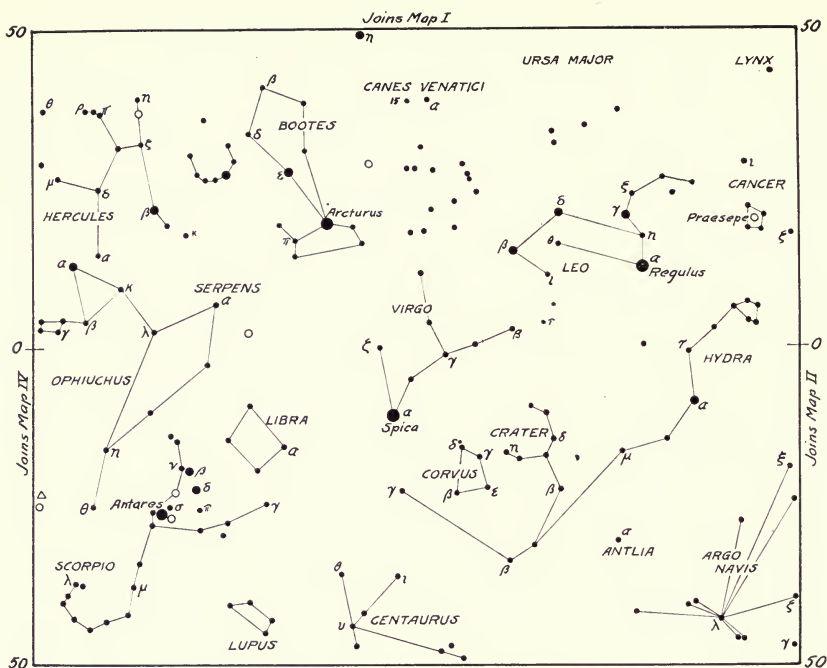
the V-shaped figure which we see in our little map—the point of the V being at the star Gamma (γ)—are called the Hyades. The group is not so compact as the Pleiades, but it is well worth examination. Note especially the little star Theta (θ) quite near Aldebaran (mags. 4.0 and 3.6). Many can divide it with the unaided eye.

Early in November, the stars of Orion begin to be seen in our eastern sky. There is no other constellation quite so impressive; and from November till late in April, when it sinks below the western horizon in the early evening, it is well-placed for easy observation. Here—as always—begin with your eye-piece of lowest power. First note the uppermost of the three bright stars in Orion's belt—the one marked Delta (δ). It is an easy "double" (mags. 2.4 and 6.8). Then turn to the little star just below and to the right of the lowest star of the belt. We refer to the unmarked star near to Zeta (ζ). It is a "multiple" star (Sigma, σ) and even with our little instrument you can clearly discern at least three of the components (mags. 5, 6.8, 6.3). Next let us look a little lower still, at the star Theta (θ). This is a region of bewildering interest. Here you will clearly observe—especially if the moon be not shining so bright as to obscure the light of other objects—the beautiful, mysterious halo of the "Great Nebula of the heavens." Almost at its center, if you will now use your 50 x eye-piece, you will discern Theta's four components, for the star is a "quadruple" (mags. 6.8, 7.9, 5.3, 6.8). Small as they will seem, you will clearly observe them as separate points of light. They form an irregular square—the famous "trapezium"—lying close together in a dark space at the core of the enfolding radiance.

Just below, note the star Gamma (γ) in Lepus (mags. 5.6 and 6.4); and to the left of Orion note the star marked 8 (mags. 4.6 and 6.7); and that marked 11 (mags. 4.3 and 5.7). These are easy and pretty doubles.

We have looked at two of the clusters easily seen with the unaided eye; now let us look at two which but for the telescope not so many eyes would find. You will see the place of the first of these, marked with the little circle, just below the bright star Sirius. A little searching with your low-power eye-piece will soon be rewarded by the sparkle of its "star-dust." The second is shown nearer the top of our map, in the constellation Cancer. Its name is Praesepe, "The Manger." You will find it slightly to one side of an imaginary line drawn from Castor to Pollux and projected southward. The myriad little stars of the cluster seem so busy in their twinkling that it has often been called "the Bee-hive."

Among the "doubles" in this quarter of the sky are the star Iota (ι) just above the "Bee-hive" (mags. 4.2 and 6.6); the star Zeta (ζ) in Gemini (mags. 3.7 and 7.0), and Castor itself, one of the most beautiful of telescopic objects (mags. 1.9 and 2.8). The two components form a "binary" system, being in slow revolution about a common center. The companion stars will seem very close together in so small a telescope, but with the 50 x eye-piece and on a clear night, a good eye will easily divide them.



GUIDE MAP No. III. This Map Overlaps Map I at the Top, and Maps IV and II at the Sides.

As with the other oblong maps, the top of this map joins Map I, partly overlapping it and therefore showing some of the stars that we noted on p. 12. Among these is the pretty "double"—not far from the Dipper's handle—marked Alpha (α) in the constellation Canes Venatici. We may now note also the very easy double quite near it marked 15; its components being magnitudes 6.2 and 6.4. These stars are shown here near the upper border of our map, about midway between the two sides. They come into good position at the northeast about the middle of February, and though rather high up in May, June and July, they are again well placed for observation at the northwest during the evenings of August and September.

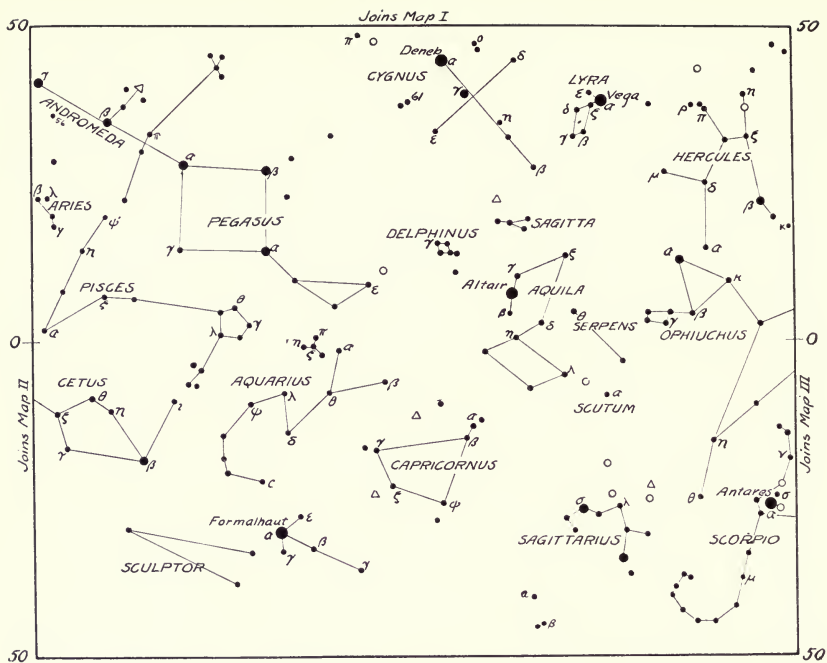
Just to the south of them you will observe the pretty groups or strands of stars called "Bernice's Hair." The name does not appear, but you will see them on our map just to the right of Arcturus. Sweep through them with your low-power eye-piece, and you will be delighted with the spectacle.

Through the early evenings of spring we shall also find the constellation Leo in our eastern sky. Leo is rather high up during the evenings of April and May, but is again in good position in our western skies during June and July. You will easily recognize it by the "sickle" formed from the stars Regulus, Eta (η), Gamma (γ), etc. First using your lowest power, let us look at the star Gamma

(γ). You will note quite near it a little neighbor-star, not its double—for it is connected with the larger star only in the line of sight—yet it presents a pleasing contrast in size and color. Now change to the highest power eye-piece you have. This, if you have a good eye and the atmospheric conditions are favorable, will show you that Gamma (γ), the larger star, is also a real double, a binary—the two components (mags. 2.6 and 3.8) being in slow revolution about a common center. With the star Gamma (γ) in Virgo (mags. 3.6 and 3.6) you will also need your highest power, but as the distance between the components is greater, even the beginner—if the night is good—will be delighted with his success. With the power of 50x, in our little instrument, it is one of the most charming objects in the sky.

One of the easiest of the “doubles” among the early evening stars of the spring and summer is Alpha (α), mags. 5.3 and 2.9, in the constellation Libra. Libra rises in the southeast during May and continues in our southern skies till it sets at the southwest in October. We may also try the star Delta (δ) in Corvus, though we shall find this more difficult. Returning now to the top of our map let us look—in the region near Arcturus—at the star Pi (π) in Bootes; mags. 4.6 and 6.0; and at Delta (δ), mags. 3.5 and 8.2, in the same constellation. Next, and to the left, you will see the stars of Hercules. While this immediate region of the sky is too directly overhead for easy observation in the early evening of August, it is in good position at the east during the early spring and at the west during the early autumn. We shall need our highest power in looking at Alpha (α) mags. 3.4 and 5.3, but even with our 25 x eye-piece we shall find a pretty double in the star Kappa (κ), mags. 5.3 and 6.5. And now let us follow the line indicated between Eta (η) and Zeta (ζ) till we come to the cluster indicated by the little circle lying between them. It is globular in form, and in a large instrument is most impressive. The elder Herschel estimated the presence within it of 14,000 stars.

Turning again to the lower half of our map, at the left, let us next note some of the objects in Scorpio. Rising at the southeast in the month of May and continuing at the south through the early evenings till they set in September at the southwest, the stars of this superb constellation are always in fine position for the observer of our summer skies. Use first your low-power eye-piece in sweeping through the whole field of these stars. Then look—using each eye-piece in turn—at the double star marked Nu (ν), magnitudes 6.4 and 4.2; and then at Beta (β), magnitudes 2.9 and 5.0. These are easy to divide and yet sufficiently close to be very interesting objects of their class. Follow, then, with your low-power eye-piece the course of the Scorpion's tail. You will find the star Mu (μ) and the region just below it well worthy of your study. The star clusters of Scorpio and of Sagittarius (Map IV), some of which are marked in our maps by the little circles, are not brilliant in a small telescope, but the finding of a few of them will add much to your appreciation of this region of the sky.



GUIDE MAP No. IV. This Map Overlaps Map No. I at the Top, and Maps II and III at the Sides.

As we begin with the stars in Map IV let us again turn for a moment to No. I, and note the position of the Dipper in relation to some of the stars near the lower border of that map. As the Dipper looms above us in the evening skies of May you will see, low down and to the right, the stars of Lyra rising at the northeast.

In Map IV, at the top, you will now observe the repetition of some of the objects of this region; you will note that Vega, the leading star in Lyra, is between the constellation Hercules, on the one hand, and Cygnus on the other; and you will see, further, that all these stars hold always the same fixed position in reference to the great Dipper. When the Dipper is high up these are in the northeast; as the Dipper sinks toward the west these rise to the meridian; as the Dipper itself wheels again into the northeast, they sink below the horizon at the northwest. To the beginner such descriptions (see also p. 12 and par. 9 on p. 36) may sound a little "complicated," yet if he will look for an evening or two at the actual skies, glancing now and then at his little maps, he will find few things more pleasurable than "the simplicity of the stars."

On a clear night Vega can always be identified by the rhomboid ("the slanting oblong square") formed by the stars Delta (δ), Gamma (γ), Beta (β), and Zeta (ζ). Of these, all except the second are double stars, the first named being the easiest to divide. The components of Delta (δ) are magnitudes 5.5 and 4.5. Beta is a "multiple," only two of the components being within the range of our instrument (magnitudes 3.3 and 6.7). The magnitudes of

Zeta (ζ) are 4.2 and 5.8. We will now direct ourselves to the little star Epsilon (ϵ). It is a very easy double, magnitudes 5.0 and 6.0, but of much more interest is the fact that each of these components is itself a double, the two pairs being in very slow revolution about a common center. The doubling of the doubles is beyond the power of so small an instrument, but the knowledge of a fact so unique in stellar history always gives a peculiar interest to them as telescopic objects.

Not far from Lyra we find those stars of Cygnus, the Swan, which form the Northern Cross. No star in the sky makes a more beautiful or more satisfactory object for our telescope than "Albireo," marked as Beta (β) at the foot of this cross. The magnitudes are 3.2 and 5.3, and the contrasted colors—a golden yellow and a smalt blue—make an especially fine contrast. The star Omicron ($\omicron$) is also an easy double (magnitudes 4.9 and 3.9), and the star marked 61 (magnitudes 5.5 and 6.2) while perhaps requiring your 50 x eye-piece for its division, is of interest as being the nearest to our earth of all the stars in the northern sky. So far away is it, however, that its light requires approximately eight years in which to reach us!

Southward from Cygnus you will find another beautiful double in Theta (θ), magnitudes 4.5 and 5.1, of the constellation Serpens. You can find it by extending an imaginary line from Eta (η) to Delta (δ) in Aquila, and continuing it an equal distance. Still further to the southward you will find a very easy double in Alpha (α) of Capricornus; many can divide the components, magnitudes 4.5 and 3.7, with the unaided eye. A closer and more interesting double is Beta (β) of the same constellation, magnitudes 3.2 and 6.0; the colors being an orange yellow and a sky blue.

The stars of this region are well placed for observation throughout the summer, rising at the southeast in July and continuing in our evening skies till they set in November at the southwest. In Aquarius you will find that Zeta (ζ) the central star of the little Y which marks the water-jar is a double, though rather difficult; mags. 4.5 and 4.2. Gamma (γ) in the small constellation called Delphinus is more easily divided; mags. 5.4 and 4.4.

Among the most conspicuous landmarks of the sky is "the Great Square of Pegasus," shown here and shown also in Map II. It is made by three of the brighter stars of Pegasus in combination with the Alpha (α) of Andromeda. It is at the east in the evening skies of August, is directly above us in November, and sets at the west in early February. The star Epsilon (ϵ), magnitudes 2.5 and 8.5, is a double, but a little difficult. In the neighboring constellation of Pisces or The Fishes, the stars Zeta (ζ), magnitudes 5.5 and 6.4, and Psi (ψ '), magnitudes 5.5 and 5.8, are easier to divide.

Starting at one of the northern corners of the Square of Pegasus, from the star Alpha (α) of Andromeda, let us now follow the line which leads through the latter constellation. We shall find here the easy doubles Pi (π), magnitudes 4.5 and 8; and 56, magnitudes 5.8 and 6.0; and at the position indicated by the little triangle near the small star Nu (ν) we shall be able to distinguish Andromeda's great nebula. Use your eye-piece of lowest power,

for you will want a large field. Choose a night clear, but not flooded by the moonlight, for you will want the benefit of contrast. This nebula is the largest of the spiral type, its diameter having been estimated as 500,000 times the distance between the earth and the sun, "light requiring eight years to travel across it." It is decidedly oval in shape, brighter at its center than at its edges. In a small instrument it is not so impressive to a beginner as is a cluster, like the Pleiades; but in its own way, in the far reaches of its faint luminous glow, it is, to the discriminating observer, quite as interesting.

The Planets



Saturn

The planets are of our own family, and revolve with our little earth about the sun. They are not themselves great self-luminous suns, as are the "fixed stars" we have thus far studied. Because the planets are thus near, and because they chiefly shine by reflected light, they show an appreciable disc, or surface outline, within the telescope, though only Venus, Jupiter and Saturn are of special interest in a small instrument. Mars, indeed, is worth observ-

ing, for his ruddy glow and perhaps one of his more conspicuous markings, but the much-discussed "canals" are for larger glasses. Saturn, however, even in a small instrument, is an object of surpassing interest.

You can easily identify Saturn by the steadiness of its yellow light. Your 25 x eye-piece will distinctly show the existence of the ring formation, but you can here use the 50 x with greater advantage. With the higher power you will see the chief peculiarity of the planet more clearly, though not on so large a scale as in our little cut, and you will also see Titan, the largest of the nine satellites. But Saturn's chief attraction is shown in our illustration, a phenomenon unique—so far as our knowledge goes—in the whole range of our universe. Because of the changes in the relative positions of the planets in reference to each other, the rings of Saturn are sometimes turned "edge on" toward the earth and are then difficult to see. This was the case in 1907, as shown in the first figure of our little illustration. But through 1909 and 1910 the rings gradually open out, permitting a more satisfactory telescopic view. They are composed of "swarms of meteors" in revolution about the planet as a center. The extreme diameter at the outer edge is more than 172,000 miles.

Venus, so splendidly beautiful to the unaided eye, has no satellite to interest us and no marked peculiarity of form. These facts, together with its excessive brilliance in a glass, make it a disappointing telescopic object. Most interesting, however, is the observation of the planet when she assumes her crescent phase, for there are periods of the year when she puts on this aspect of the new moon. It is an aspect of her charm which will be presented when she shines at her brightest in the west during the evenings of January, 1910, and in the east during the mornings of March and April, 1910.

Jupiter and his satellites will form a delightful and inexhaustible source of interest and pleasure. Even with the 25 x eye-piece four of the eight moons are distinctly visible in our little instrument, and the field of view is so large and so well lighted that the spectacle is peculiarly satisfying. With the 50 x eye-piece they are brought out even more vividly; and by a good eye, under favorable conditions, the cloud-belts across the body of the great planet may be discerned. The movement of the satellites is so rapid, as they revolve in their orbits, that we can see them change their relative positions almost from hour to hour; one night three will be upon one side the planet, one upon the other; the next night there will be two on either side; and, yet again, as the satellites are hidden by the body of the planet, or are eclipsed, or are in transit across his huge disc, one or more of them will be wholly hid from view.

References to familiar sources of information for the easy finding of the planets, together with other inexpensive literature concerning their nature and their movements are given in note 10, paragraphs 2 and 4, p. 38.



Part II.

The Moon

The Moon

Some Interesting Lunar Objects

The user of our Prism Terrestrial Telescope will find especial pleasure in the observation of the moon. Not only does the excellent definition of the instrument show the lunar topography with remarkable clearness and fullness of detail, but the very fact that a terrestrial telescope does not invert the image—as is the case with astronomical telescopes—is of much satisfaction to a beginner. Our halftone engravings and our miniature key-map are presented, therefore, “right-side-up,” in harmony with the view as observed in a terrestrial instrument and in conformity with the natural expectations of the eye.

As you look at our first photograph of the moon you will see that the objects on its surface are made distinct to us by the lunar shadows. As the sunshine dawns or dies away over plains and mountains, the objects near the edges of the advancing or receding light are brought into sharp relief. In the direct illumination which obtains when the moon is “full,” we can see little detail, for shadows are then largely absent. Looking at each of our photographs in turn, you will now be able at once to understand why the same object—such as Copernicus, the huge crater-mountain marked No. 28 in our key-map—should present so different an aspect at different times. These ceaseless changes caused by the different angles at which the sun’s light strikes the surface make one of the chief fascinations of lunar study.

But in order to show clearly all of the chief objects on the moon by the photographic process, we should thus have to present dozens of pictures instead of two. These two, however, are enough to explain the constant changes of illumination and to illustrate the value of our little key-map. Without the key-map and this accompanying explanation you might possibly infer from the photographs themselves that the objects lying outside the shadows—in the darkness, or in the confusion of the direct light—are always hidden from observation. On the contrary, the region of the moon toward the reader’s right, which seems obscured in the moon at nine and three-quarter days by the direct glare (the objects numbered 1, 2, 3, 4 in the key-map) are as clear when the moon is younger (two to four days old) as is Copernicus (No. 28) in our first engraving.



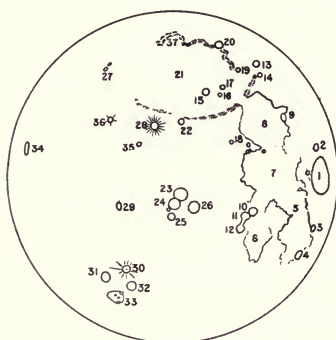
The Moon at Nine and Three-quarter Days

With the moon, as with the stars, do not assume—as beginners are so apt to do—that the more powerful eye-piece is necessarily the first that should be employed. As the lower powers always afford a much larger field of vision, it is always well to use the 25 x in locating the object in the telescope. Then the 50 x eye-piece may be substituted. If there is haze or mist, the lower power may well be retained; if the atmospheric conditions are good, you will of course gain with your higher power a greater fullness of detail and much larger magnification.

Early in our study of the moon let us mentally mark and note the general position of some of the greater “seas,”—not seas in fact, but dark plains upon the lunar surface. Their quaint names were given them many generations ago. That marked No. 1 was named

"The Sea of Crises," or "The Sea of Conflicts." We roughly translate the Latin titles. That marked No. 5 is the Sea of Fecundity; No. 6 is the Sea of Nectar; No. 7 is the Sea of Tranquility; No. 8 is the Sea of Serenity; No. 21 is the Sea of Showers.

The Sea of Conflicts, No. 1, seems to be longer from north to south (up and down) than from east to west. This, however, is an optical illusion, due to foreshortening; its width, from north to south, being about 280 miles, and the distance from its eastern to its western boundary being over 350 miles. Two craters may be



Miniature Key Map

readily discerned within it—the lower having the name Picard, the upper being called Peirce. These are so small that while they may be readily seen with the telescope when the Moon is about four days old, they are not indicated in the key-map. No. 1 and its neighboring objects—as already stated—are seen in clear and beautiful detail in the very new moon. This great oval plain comprises about 66,000 square miles. Just above it, marked No. 2 in the key-map,

is Cleomedes, a smaller formation, a walled plain 78 miles in diameter. A little way below No. 1 is the crater Langrenus, No. 3, with its terraced ring over 9,500 feet high. The next crater—except one which we do not mark—is Petavius, No. 4, the eastern side of its great double rampart being 11,000 feet in height. All these objects, as has been said, are too directly lighted to be well seen under the illumination of the nine or ten day moon, so they appear only as bright patches in our first photograph.

In the objects numbered 10, 11, 12 we again find almost "drowned in light," three peculiarly interesting craters which in the younger moon—at about six days old—are superbly clear. In this particular case, however, we find recompense in our second photograph. For, ten days later, in the receding light of the sun, these objects—Theophilus, Cyrillus and Catharina—are again defined in the lines of grateful shadow.

Theophilus, No. 10, is probably the deepest of the moon's craters, the general line of the ring being from 14,000 to 18,000 feet above the chasm. Of this triple group, it "first catches," says Webb, "the rising sun, and I have seen it far beyond the terminator (the shadow line) and even without the telescope, five days after new; it is a grand object when filled with night, through which its glittering central peak comes out like a star." In our



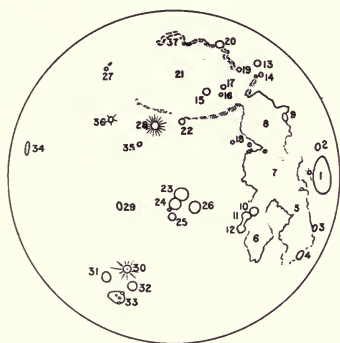
The Moon at Eighteen and a Half Days

second photograph, in the now retreating shadows of the sun, you can clearly see the bright cap of this central peak.

Cyrillus, No. 11, is even larger; and Catharina, No. 12, is perhaps the largest of the three, irregular in character but more than 16,000 feet deep. As with all the objects of our study these craters should be observed under different illuminations. If possible, it is well to make two observations on the same evening—one at an early hour and another somewhat later. And in using the little key-map, each object specified should be examined with the aid of both our photographs.

As our little telescope will clearly show more than three hundred objects upon the moon's surface—each having its own distinct

and proper name—it is obviously impossible here to indicate them all. And upon the beginner the effect of so much detail would be confusion and discouragement rather than information and pleasure. We confine ourselves to approximately forty objects. Even this number will seem bewildering to the novice. We suggest, therefore, that for the first few evenings of his observation he rigorously confine himself to four or five. Let him get these well in mind. Then, with these as landmarks, he will be surprised and delighted to see how rapidly his information will advance.



Miniature Key Map

We have already spoken of the objects 10, 11, 12—conspicuously lighted in our second photograph as well as in the six and seven-day moon. In the nine-day moon we shall find another triple group (23, 24, 25 in the key-map) called Ptolemy, Alphonsus, and Arzachel. This group is shown in both our photographs. Quite near the edge of Alphonsus you will observe the smaller crater called Alpetragius—one of the deepest on the moon. To

the right, No. 26, is Albategnius. One cannot but feel a strong desire to change some of these formidable names!

We have hastened to speak of the triple group 23, 24, 25 chiefly to prevent its confusion with 10, 11, 12. We will now return to some of the earlier numbers. In No. 9 of our key-map we again have an object shown in our photographs under two different lightings. This is Posodonus, a walled plain about 62 miles across, containing a small but sometimes brilliant crater. No. 18 is Manilius, and to its right is Pliny. The former is over 7,500 feet deep and about 25 miles in diameter. No. 13 is Aristotle, No. 14 is Eudoxus; a superb pair of craters, the terraced wall of the former, over 11,000 feet high, being crowned by two turrets of 15,000 feet. In this great cavity, says one authority, the Mount Etna of our earth could stand. No. 19 is Cassini, a ring-plain with a small deep crater. No. 20 is Plato, well shown in both our photographs, a great ring-plain 60 miles across. Above Plato lies the Sea of Cold; below Plato is the Sea of Showers, and within the latter we have marked for special consideration the objects numbered 15, 16 and 17, Archimedes, Autolycus, and Aristillus. The range of mountains terminating at Eratosthenes (No. 22) is known as the Apennines, a chain somewhat like the mountains of the earth. Its length is 460 miles. To the left of No. 22 lie the Carpathian Mountains, and in No. 28 we have one of the most superb of lunar spectacles,

the huge crater Copernicus, 56 miles in diameter. It is the center, as may be seen in our second photograph, of one of those systems of light radiation which form one of the most striking features of the moon's aspect. Another center of these radiations, as you will see, is Kepler, No. 36. No. 27, Aristarchus, is usually regarded as the most brilliant single point upon the moon. No. 34, Grimaldi, is by contrast the darkest of the lunar craters.

In No. 29, seen far better in our first photograph than in our second, we have Bullialdus, a great crater, 9,000 feet deep and 38 miles across. No. 35 is Rheinholdt. We turn now, however, to the southern or lower quarter of the moon's surface in order that we may close our brief descriptions with a word concerning a few of the objects in the neighborhood of No. 30, Tycho, "the metropolitan crater." The whole region is one of mighty cataclysm, of appalling heights and depths. Longomontanus, No. 31, is apparently one of the oldest of volcanic formations, its great walls having been rent and shattered by recurrent explosions. Maginus, No. 32, is one of a number of lunar objects which, while presenting a superb spectacle under certain phases of illumination, are entirely invisible at full moon. Clavius, No. 33, is especially interesting by reason of the craters within its limits; their shadows are finely outlined in the lunar sunrise. This, and many objects which must necessarily be omitted from a list as brief as the present one, may be further studied in some of the publications cited in par. 10, p. 38.

The great crater Tycho, No. 30, is not only of unique interest in itself, but is the central point for the most splendid system of radiations on the moon. In both our photographs the reader can partially see the spreading of these lines of light. So brilliant do they become when the moon is full that this huge crater dominates the scene, the light-streaks extending from it in all directions. Webb calls Tycho "a most perfect specimen of the lunar volcano, roughly figured by Galileo in the earliest telescopic representations. Its diameter is 54 miles, its depth 17,000 feet or nearly three miles, so that the summit of our Mont Blanc would drop beneath the ring. Its vicinity is thronged with hillocks and small craters so that for a long distance not the smallest level spot can be found; further off the craters increase till the whole surface of the region resembles a colossal honeycomb."

"There are," says Noble, in his "Hours With a Three-inch Telescope," "few more curious, instructive, nay even startling sights in the heavens than the occultation of a fixed star, or

more rarely of a planet, by the moon. When this occurs at the dark limb of our satellite, its suddenness is such as not infrequently to extort an exclamation from the observer who witnesses it for the first time. . . . In describing her monthly path over the celestial vault, it is quite obvious that the moon must pass between us and such stars as lie in her course; the stars being—for our present purpose—at an infinite distance, while she is only some 239,000 miles from us. . . . Travelling thus, as I have said, from west to east, her eastern limb is, of course, the leading one, or that which covers, hides, or occults objects lying in her path. From new moon to full moon this limb is unilluminated, and the effect of the extremely sudden extinction of a star when the dark limb hides it is, as I began by saying, of an absolutely startling character. ‘In a moment, in the twinkling of an eye,’ the star which shone as a brilliant point in the sky is blotted out; and its place seemingly knows it no more, until it reappears from behind the opposite or illuminated edge of the moon. After full moon, of course, the eastern limb is illuminated, so that the disappearance takes place at the bright edge, and the star on its reappearance starts instantaneously from behind the dark limb.” The more interesting occultations are fully predicted and enumerated in the Whitaker’s almanac mentioned in the closing paragraph of note 10, page 38.

In addition to the literature concerning the moon, as mentioned in note 10, page 38, we also refer to “The Moon in Modern Astronomy” by Philip Fauth, with an introduction by J. Ellard Gore, F. R. A. S.; published by the Van Nostrand Co., New York. Without endorsing, necessarily, some of the theoretic contributions of the volume we are sure the amateur astronomer will find much pleasure in its illustrative and descriptive matter.

Part III.

Notes and Suggestions

Notes and Suggestions

1. Readers of this booklet are advised—before beginning the specific use of any particular part of it—to read it through as a whole. The suggestions made at one point will often prove helpful in other connections.

2. Our half-tone engravings of the moon are reduced from direct contact prints of negatives made with the great 40-inch Yerkes telescope, designed and constructed by The Warner & Swasey Company for the University of Chicago at Williams Bay, Wisconsin. As all photographs taken with an astronomical telescope show the object inverted in the field of view, the above prints are presented “erect” in this booklet, in conformity with the requirements of a terrestrial instrument.

3. The user of a camera expects to make a few failures before getting the best results, the user of any form of mechanical equipment—whether it be the bicycle, the automobile or even a pair of roller skates—expects to put a little thought and care into the mastery of the machine. It is so with a telescope. While far simpler than the “modern creations” which we have mentioned, the beginner should not begrudge the expenditure of a little thought and time if he would gain intelligent command of the instrument itself and of the resources which it will bring him.

4. It is to aid the beginner in one department of its use that this booklet has been prepared. Yet it is not intended as a library on astronomy or as a complete telescopic manual. The little maps are necessarily inadequate and are not presented as a substitute for such a “star atlas” as the advanced amateur will desire. In maps so small many stars must necessarily be omitted; other and perhaps smaller stars—because of some special telescopic interest, or because of their connection with the constellation figures—have been included. The diagrams are offered just as rough approximate guide-maps for elementary telescopic work.

5. While our references to particular stars are so clearly given as not to necessitate the memorizing of the Greek alphabet, that alphabet is here printed as a matter of convenience to the beginner. A general familiarity with the characters is easily acquired and indispensable in the use of larger star-maps: Alpha, α ; Beta, β ; Gamma, γ ; Delta, δ ; Epsilon, ϵ ; Zeta, ζ ; Eta, η ; Theta, θ ; Iota, ι ; Kappa, κ ; Lambda, λ ; Mu, μ ; Nu, ν ; Xi, ξ ; Omicron, $\omicron$; Pi, π ; Rho, ρ ; Sigma, σ ; Tau, τ ; Upsilon, υ ; Phi, ϕ ; Chi, χ ; Psi, ψ ; Omega, ω .

6. As already suggested on p. 12, the use of a plain straight-back chair, without arms, will be of much service to the observer employing so light an instrument. As he takes his place in the chair the instrument may be drawn toward him, and—sitting almost directly beneath the tripod, a leg of the tripod falling naturally into position at each side of him—he will be able with very little adjustment of the telescope to command almost any altitude. Stars obscured by mists at the horizon or inconveniently high up may be permitted to wait the observation of those at better range. If the beginner will early learn to take what Fortune brings, he will always find that Fortune, whatever her negligences, will surely bring the stars again. At a later hour on the same evening, or at the same hour on a later evening, he will be rewarded.

7. Among the interesting astronomical phenomena of 1909-1910 is the return of Halley's comet, after an absence of nearly 76 years. The comet in October, 1909, will be not far from the little star marked Nu (ν) in Orion (Map II). You will see this star just above the bright star Betelgeuse, and a little to the left. Passing westward through the constellation Taurus the comet will move along the southern part of the constellation Aries, and from thence—as we watch it from week to week—we shall see it pass into the region of Pisces, the Fishes. A telescope will probably be needed for its observation during the autumn of 1909, but by the early spring of 1910 it is likely to be a conspicuous object even to the unaided eye. Its visible advance into our skies will, of course, be first heralded by those commanding larger instruments; the possessor of our two-inch terrestrial will thereafter find much interest in observing its first appearance and its gradual brightening under the modest powers of his own telescope.

8. Some one has well said that "the most important part of a telescope is the man at the small end of it." This is but a recognition of the fact that there is such a thing as a trained eye—as well as a trained hand or a trained will. The beginner may be sure, therefore, that as he extends his familiarity with his instrument and as he gains in clearness and accuracy of vision, his telescope will be an increasing satisfaction. Two of the personal conditions of good-seeing may be especially commended: Work in comfort, and work with deliberation. Holding the telescope in trying positions, getting the head or body into fatiguing or unnatural attitudes, are directly embarrassing to clear, accurate seeing. And because we thus see with the mind as well as with the eye, much of the reward of exquisite vision is found in deliberation. Do not rush from star to star. In looking, for example, at a beautiful double star like the Gamma (γ) in Andromeda—see p. 14—quiet, thoughtful observation, after you have secured a sharp focus, will add much to your real pleasure in what you see. In this case, you are looking at two splendid suns thousands of millions of miles distant from our earth, so different in their chemical constitution that their contrasted colors are at least partially conveyed to us through all the intervening space.

9. In our little map at the top of p. 12 the Dipper is shown in its approximate position for the early evening of May 1st. As

it turns westward (to the observer's left), the two stars marked "The Pointers" (no matter what the position of the Dipper), will always indicate the direction of the bright star, Polaris, or the Pole Star, which lies nearest to the polar "hub." All the stars in our little map, ever keeping the same permanent relations to each other—as though fixed on the respective spokes of a great wheel—revolve also, as does the Dipper; but Polaris lies so near the pole of the heavens that its motion is almost unappreciable; it seems to the "wayfaring man" to stand ever fixed at the true north. It is also, as you can see, the leading star in the "Little Dipper," part of the constellation called "Ursa Minor."

Still looking at our first map, you will see that the further a star is from the pole the larger must be the circle it describes, as the great wheel revolves; and that the stars located further out on its spokes (to continue our figure) will, with the wheel's turning, dip below the horizon for a shorter or longer period. Those, however, that lie within about forty degrees of the pole are never carried quite out of the sight of observers in the latitude of Cleveland and New York; they are called the stars of the "circumpolar constellations." These are roughly indicated in Map I, and are always in our night sky.

The stars that are further from the pole are indicated in Maps II, III, and IV. They pass out of our night skies for shorter or longer periods of time; and as we come to study them we shall see that our figure of speech must be changed. For, as we look toward the true north, we are gazing not strictly at the hub of a flat wheel, but toward the pole of a hollow sphere,—its apparent axis the projection of the earth's axis, and its equator the projection of our own equator. We may imagine the spokes of the revolving wheel—as they extend—gradually bending inward toward us, and forming the ribs of a vast including globe. We stand—enclosed as it were—at the sphere's center.

The circumpolar stars turn with the sphere itself, but as they lie so near its pole, the circle of their revolution never carries them below our horizon. Sometimes, for example, we see the Dipper above the North Star, sometimes below it; sometimes it is a little to our left, the bowl slowly turning downward, sometimes it is toward the right with the bowl climbing upward, but it is always in our northern sky. Yet, with the sphere's turning, the stars further from the pole (Maps II, III, IV), like bright points fixed on the inner surface of its concave sides—as these arch themselves above and below the horizon—appear and disappear according to their hours and their seasons. A few minutes of actual observation for a couple of evenings will make this subject clear, even to children of grammar-school grades. An admirable and much fuller exposition of the diurnal motion of the stars will be found in Newcomb's volume, mentioned on p. 38.

10. The beginner may wish to supply himself with a few volumes that will help to enlarge his knowledge. First, he will enjoy gaining some measure of familiarity with the chief constellations. Among the best helps here are Olcott's "Field Book of the

Stars," published by Putnam's, New York; and Serviss's "Astronomy with an Opera Glass," published by D. Appleton & Co. A Planisphere will be found a most useful device for ascertaining the positions of the stars from night to night. An inexpensive one is sold by Thomas Whittaker, 2 Bible House, New York. As a substitute, readers of French may prefer to use one upon the same plan as Whittaker's, called the "Carte Celeste," published by Burkhardt, 2 Place du Molard a Geneve, to be had through any of Brentano's book-stores.

Readers of German will find attractive star maps and excellent descriptive matter in the Stern-Atlas of Jacob Messer. The "Himmel Atlas" of Schurig is less expensive and the new edition is extremely useful even to those who do not read German. Both volumes may be had of G. Steckert, 129 W. 20th St., New York. Among English atlases may be mentioned "The New Star Atlas," by Proctor, published by Longmans, Green & Co.; and Sir Robert Ball's "Popular Guide to the Heavens," published in New York at \$4.50, by Van Nostrand. The latter contains not only a star atlas, but charts showing the position of the stars from month to month, simple tables for finding the planets, photographs of clusters and nebulae, and admirable maps of the moon, etc.

Among the many interesting books upon the general principles and facts of astronomy, we may mention S. P. Newcomb's "Popular Astronomy," published by the American Book Co. It is especially clear and able in its expositions. Among other admirable text-books may be mentioned those by Todd, Young, and Moulton. Our little cut of Saturn on p. 20 is drawn from a portion of a cut in Prof. Todd's "New Astronomy," the American Book Co., New York. In the use of the telescope, whether in observing the moon or the stars, the advanced amateur will want some such volume as "Webb's Celestial Objects for Common Telescopes," 2 vols., \$1.75 each; London and New York, Longmans, Green & Co. Much of it will be too advanced for the beginner, but even very early in his work he will find a great deal in it to give him pleasure. Among more popular books, Noble's "Hours With a Three-inch Telescope" (Longmans, Green & Co.) is especially useful and interesting for its chapters on the moon.

In following the course of the planets the beginner will find a good almanac almost indispensable. The astronomical matter published in the New York Tribune almanac and in the almanac of the Brooklyn Eagle usually presents a simple table showing in which constellation each planet may be found from week to week throughout the year. The best almanac, however, for the amateur astronomer is undoubtedly the English "Whitaker's," published at 12 Warwick Lane, London—not to be confused with the American house publishing the planisphere. This almanac may be secured through any large bookseller. Its tables of the interesting astronomical phenomena for each month are especially full and valuable; and the movements of the planets and the configurations of the satellites of Jupiter, etc., are presented with simplicity and

clearness. "Whitakers" may be had in several editions, ranging from about 30c to \$1.00 in cost.

11. After the beginner has become familiar with his instrument and with the telescopic objects already mentioned, he may find it interesting to try some additional double stars. The following list is, of course, not complete, and of the objects enumerated some are easy and others are more difficult. If you do not succeed with a specific star on one evening, try it on another. Changes in atmospheric conditions are more frequent and more important than many amateurs realize. In Map I, try—in the constellation Draco—the star Psi, ψ (mags. 4.9 and 6.0); and the star Omicron, $\omicron$ (mags. 4.8 and 7.6). In Cassiopeia, try Iota, ι (mags. 4.8 and 8.1). In Perseus, note Eta (η), mags. 3.9 and 8.5. In Ursa Minor, the star Pi, π (mags. 6.9 and 7.6); in Cepheus, Beta, β (mags. 3.5 and 8.0). In this constellation, the star Mu, μ , while not a double is one of the most famous of the red stars—called by Herschel a "garnet." In Map II, try in Auriga the star 14, mags. 5.1 and 7.2; in Aries you will find easy doubles, both in Lambda, λ (mags. 4.8 and 8.0); and Gamma, γ (mags. 4.8 and 4.7). Note the Lambda, λ , in Orion (mags. 3.6 and 5.5). In Eridanus, try the stars marked 6 (mags. 5.7 and 8.0), 55 (mags. 6.0 and 7.1), and 32 (mags. 4.8 and 6.4); and in Cancer, the star Zeta, ζ (mags. 4.8 and 6.5). In this case as well as in a few others, the star appearing as a double in a small telescope is really a triple or a multiple as viewed in a larger instrument. It may also be interesting to note two of the important "variables" shown in Map II. We have already spoken of the star in Perseus marked Beta, β . The regular variations in the brilliancy of its light are so remarkable that the Arabs called it "Algol," the Demon. At minimum it sinks to fourth magnitude, but it so remains only about 15 minutes, when, within $5\frac{1}{2}$ hours, it becomes again a second-magnitude star. Another remarkable variable in our map is Mira, in the constellation Cetus, the Whale. Its "period" is longer, being over 331 days, but it varies regularly from absolute invisibility, for the naked eye, to a star of the second magnitude! Toward the bottom of Map IV, at the right, you will note the Alpha (α) and Beta (β) of Sagittarius, the Archer. The star β' , if you are living far enough south to command a view of it, is an interesting and easy double (mags. 4.2 and 7.2).

12. The beginner, in noting the little table of symbols (Map I), will see that the smaller the value of the numeral the higher the magnitude of the star. A first magnitude star is a very bright one, an eighth magnitude star is a very faint one. Little attempt has been made in the maps themselves to secure absolute accuracy as to these magnitudes—the drawings are necessarily too small for the varied use of many different symbols. But in the text of our descriptive matter the magnitudes of the components of the double stars are given according to the revised Harvard Photometry for 1908; or, in the cases of a few small components not included in that list, according to the "Sternverzeichnis" of Ambronn, University of Gottingen, 1907. The "magnitude" of a star has no necessary relation to its actual size; the term refers solely to its apparent brightness as seen from our earth itself. Many of the fainter stars

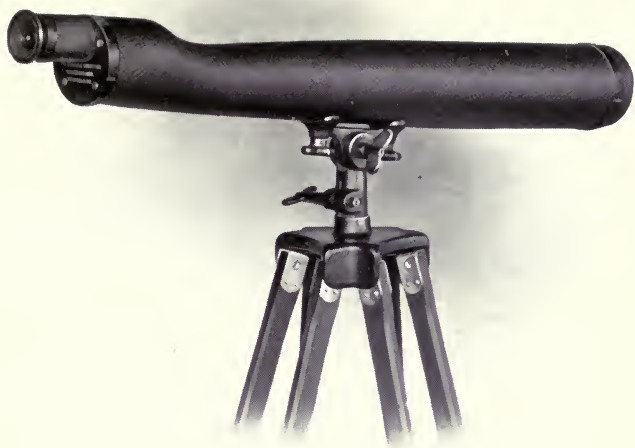
may be actually larger and more luminous than those we classify as first magnitudes, their apparent faintness, in such cases, being due only to their greater distance.

13. This factor of distance in the observation of the stars is so great that it wholly transcends all our ordinary conceptions of space. Yet a lack of knowledge upon this point is the occasion—among beginners—of much disappointment in the first using of a telescope. Do not expect your telescope, however large in size or fine in quality, to lend a large surface image or a broad sensible disc to any of the “fixed stars.”

With the moon and with the planets, as we have seen, things are slightly different: these are relatively very much nearer to the earth. But so remote are the hosts of the stars proper (the very nearest being over twenty-five millions of millions of miles distant) that no telescope, however great, will ever make them in the popular sense any “bigger.” The highest power usually provided with our little instrument is 50 diameters. Let us suppose, however, that we were able to use a telescope affording us a magnification of 5,000 diameters. As such a power would magnify all the conditions of atmospheric obscurity or disturbance (as well as the star) there are few of us who could get any satisfaction from it. But on the assumption that we could use it under fine atmospheric conditions what would it mean to us? It would bring a star that might be 50,000 million miles from us to a distance of 1,000 million miles! That is not very near, is it? But there is no star so near as 50,000 million miles: nor any so near as 500,000 million miles. The very nearest, as we have said, is 25,000,000 million miles away—and no star even so near as that is visible to us north of our tropic latitudes.

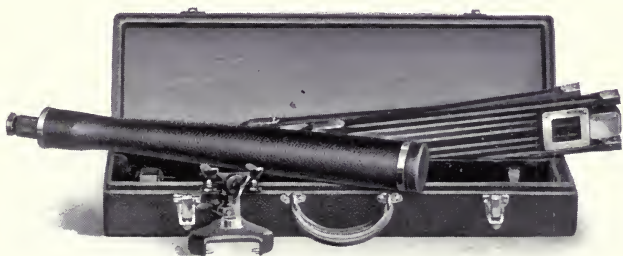
Astronomers, accordingly, ignore the mile as a unit of measure. Their unit is the light-year, the distance traversed by light—speeding at 186,330 miles a second—in a year of time. Our North star, for example, is at a light distance of 40 years—that is to say the light by which the mariner may now take his reckoning (1909) was started on its way toward us in 1869. As you bear these distances in mind you will not find fault with your little telescope if it does not make a star assume the proportions of a dinner-plate. But if you will employ your instrument under some of the simple instructions of the preceding pages, you will find that it will give you results even more interesting than the mere enlargement of size.





Specifications

Objective—clear aperture	.	.	.	.	2 inches
Powers—two eye-pieces	.	.	.	.	25 and 50
Length of telescope	.	.	.	.	21½ inches
Weight of telescope	.	.	.	.	2½ lbs.
Weight of tripod and alt-azimuth mounting	.	.	.	.	4 lbs.
Weight, complete with carrying case	.	.	.	.	12 lbs.
Dimensions of carrying case	.	.	.	.	12 x 6½ x 4½ inches

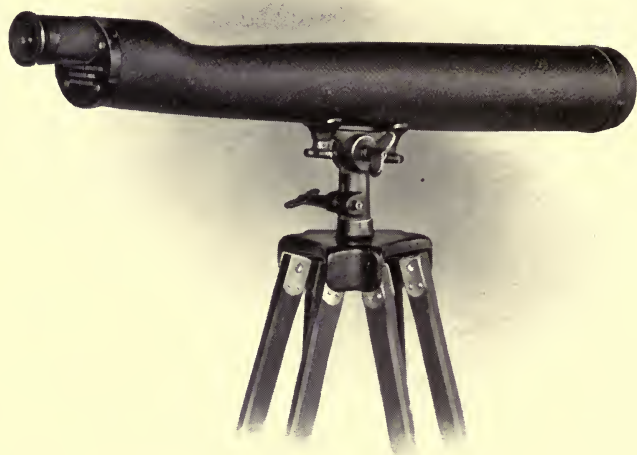




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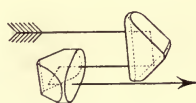
Cleveland, Ohio, U. S. A.



SPECIFICATIONS

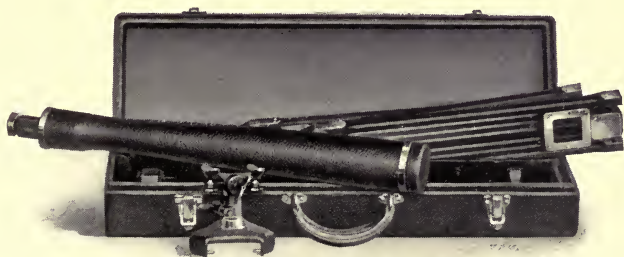
Objective—clear aperture	-	-	-	2 inches
Powers—two eye-pieces	.	-	-	25 and 50
Length of telescope	-	-	-	21½ inches
Weight of telescope	-	-	-	2½ lbs.
Weight of tripod and alt-azimuth mounting				4 lbs.
Weight, complete with carrying case	-			12 lbs.
Dimensions of carrying case	-	24 x 6½ x 4½		inches

THE WARNER & SWASEY PRISM TERRESTRIAL TELESCOPE



*Path of Light through
the Porro Prisms*

THE 2-inch Porro Prism Telescope is designed expressly for use as a terrestrial instrument. Its large field, high magnification and superior construction represent the highest development in terrestrial telescopes. As an example of its excellence, it will show clearly so delicate an object as the moving second hand of a watch at a distance of 300 feet. At from five to seven miles, in good atmospheric conditions, it will reveal the time of day by the town clock in the old meeting house tower, while at ten miles or more what appeared as mere specks are sharply brought out as recognizable objects; that white dot is a quarry of building stone, not a house. In other words, the 25-power eyepiece brings the object apparently twenty-five times nearer and the 50-power eyepiece fifty times nearer. Of course, atmospheric conditions modify the "seeing." On a clear day, with no wind, an object can be seen farther and better than in hazy weather, but under any conditions The Warner & Swasey Prism Terrestrial Telescope enables the user to see more and better and farther. It is the ideal instrument for terrestrial use.





THE WARNER & SWASEY PRISM TERRESTRIAL TELESCOPE
Complete with
ALT-AZIMUTH MOUNTING, FOLDING TRIPOD
AND CARRYING CASE

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